PACIFIC PARK SCIENCE

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NATIONAL PARK SERVICE

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A report to park managers of recent and ongoing research in parks with emphasis on its implications for planning and management

From the Editor . . .

Take two events widely separated in time and space – interpret them in terms of the human reactions they touched off – give the scientific evidence of the interconnectedness of these events both in geologic and in human impact terms – and you have the ingredients for an immeasurably heightened "visitor experience."

Mount St. Helens and Sunset Crater, NM are only the most recent and dramatic examples of how "tying together" seemingly separate events and information can enrich interpretation and make outstanding use of the scientific research that takes place in and around parks.

The cataclysmic explosions of May 18, 1980 in the state of Washington and of a similarly ash-blackened day in 1065 A.D. 80 miles south and east of the Grand Canyon not only make excellent grist for the NPS interpretation mill, but they take advantage of the visitor interest already at white heat, thanks to the St. Helens eruption. The similarities between the two explosions have drawn increasing visitation to Sunset Crater, despite the rising cost of fuel. Interpretive planners are meeting this interest more than halfway by turning the scientific evidence that links the events into a fascinating story for visitors – and casting the presentation in terms of human impact, then and now. Thoughtful visitors have even brought to Sunset Crater samples of volcanic ash from St. Helens for incorporation in the Sunset Crater visitor center exhibit.

Glen Hinsdale's superlative piece of interpretive writing, "The Incident at Mount St. Helens," – reported in Pacific Park Science's Fall 1980 issue – touched off the interest of Denver Service Center interpretive planners (see item p. 3) and the connection gave rise to the current interpretive effort at Sunset.

News of this salutary use of scientific information by interpreters was underscored by several phone calls from interpreters around the nation, commenting on the unexpected wealth of interpretive material they were picking up from Pacific Park Science . . . expressing appreciation for help in pin-pointing where specific information can be found.

This is a side of our bulletin's mission we haven't emphasized yet. Delightfully, recognition of it has come first from the field. Our first job was – and remains – to report research in terms of its applicability to the solution of management problems. This, in turn, requires reporting it in terms that don't require a Ph.D. to decipher. And THIS brings the whole fascinating scientific level of park understanding into the realm of interpretation for visitor edification.

And finally, this brings us to a specific invitation to the field – managers, maintenance people, interpreters – all of you who serve the parks and the public from out there. You are cordially invited to use these pages to propose solutions – to ask for solutions – to suggest needed research – to do, in short, whatever you feel is needed to help you manage and maintain and interpret the areas you serve.

We felt in the beginning – and the feedback since we started is convincing evidence that the feeling was justified – that much more could usefully be made of the information we already have and are continuing to accumulate. The clearinghouse and connective nature of this quarterly bulletin serves that objective: To make everything we do in the area of scientific research as widely available, as easily applicable, and as thoroughly understandable as the printed word makes possible.

In this Issue

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Cover Photo:
Riparin habitat *along the Gunnison River within Curecanti National Recreation Area. Pictured is the "Neversink" developed area just east of Blue Mesa Lake Reservoir. NPS Photo*

Riparian Resources And Endangered Ecosystems

By R. Roy Johnson
(First of two articles)

Nowhere is the term "conserve and enjoy" more appropriate than for the rivers of our National Park System. A national park without a river is a rarity indeed. Some of the most magnetic park attractions are along rivers: the grand canyons of the Colorado and the Yellowstone, the Rio Grande in Big Bend and the Merced River in Yosemite Valley. Falls along these rivers are among our most photogenic sites. Yosemite Falls, the falls of the Yellowstone, and in the Grand Canyon, Lava Falls – the king of North America's navigable whitewater rapids.

Thus, riverine landscapes are an important part of our National Park System. Other areas that have been designated specifically because of rivers include such national recreation areas as Lake Mead, Lake Powell, and Flaming Gorge. Outstanding rivers named as national or wild and scenic riverways vary from small streams such as the St. Croix to "the nation's river" – the Potomac.

Great emphasis has been placed on management of aquatic resources and water based recreation. Millions of visitors annually engage in whitewater recreation, fishing, swimming and other stream based activities. They launch, beach, camp and picnic on the banks of those streams. Thus, riparian (streamside) research and management is at once one of the most important and most neglected of the natural resource areas today.

A computerized bibliographic search of biological literature, conducted recently through a joint effort by the Eisenhower Consortium of the Rocky Mountain Forest and Range Experiment Station and the NPS/CPSU at the University of Arizona, found tens of thousands of citations referring to papers on aquatic or upland biology. For riparian literature, the count was in scant hundreds. Eight aquatic fishery biologists and six coastal specialists are listed in the NPS "1980 Science and Technology Directory" while only one riparian ecologist made the pages. In a riparian syposium by Johnson and Jones (1977), published by the U.S. Forest Service, David Patton pointed out that of 24,000 research resumes in the U.S. Department of Agriculture's Current Research Information System (CRIS) only 10 related to riparian habitat.

A situation similar or worse in many other resource management agencies despite the undeniable importance of riparian resources, points strongly to the need for more and better research in this vital area.

NPS natural areas have been established for the preservation and maintenance of natural processes that occur in native ecosystems. The Grand Canyon (one of the original seven wonders of the world), Everglades, and Yellowstone NPs are world renowned for their scenic grandeur, and large numbers of visitors flock to these parks. In addition, riverine environments in many of our recreation areas such as Curecanti and Whiskeytown-Shasta-Trinity, support outstanding riparian habitats . . . prime arenas for a variety of visitor activities including camping (permitted in many of the areas), hiking, picnicking, photography, and "nature watching" in general.

Since the natural attributes of these areas are what make for their recreational value, a lessening or loss of any of these natural values leads to a correlated loss in recreational opportunities. Yet we tend to expend large percentages of the manpower and budgets in our natural areas for visitor services with very little reciprocal effort toward a commitment to *resource* management in recreational areas.

This can allow for neglect of the very set of natural factors that originally led to establishment of the recreation area.

Protection and proper management of riparian areas on NPS lands loom as critical when one considers that these areas are high on the list of the most endangered native ecosystems of North America.

Riparian areas are preferred habitats for wildlife, cattle, and recreationists, both consumptive and nonconsumptive. Such areas also serve as choice sites for farms, cities, vacation lands and parks. Most of the population centers in the U.S., or the world for that matter, occur along rivers. Overuse has led to drastic reductions in the extent of riparian habitat. Swift and Barclay, U.S. Fish and Wildlife Service, estimate that at least 70 percent of the original riparian ecosystems have been destroyed. This may be an optimistic figure. An interagency team estimates that less than 2 percent of the original riparian habitat of the Sacramento River Basin of California remains. At the 42nd North American

Brandy Creek Beach *provides a swimming area and a popular picnic spot on the tributary to Whiskeytown Lake at Whiskeytown NRA.*

Young visitor *enjoys the cool spray of a waterfall from astraddle a log over upper Brandy Creek at Whiskeytown NRA, California.*

Wildlife and National Resources Conference (1977), Korte and Fredrickson estimated that more than 95 percent of the riparian lowland forests in Missouri have been cleared. Only about 5 percent of that state was covered by this type of forest when Missouri was settled. Now only 98,000 of the original 2.4 million acres, or .4 percent of the state supports this important habitat type. The rest has been replaced largely by agricultural and urban developments, making the picture particularly bleak in lowlands and agricultural areas.

Why then, the discrepancy between the obvious importance of riparian areas and the lack of a concomitant effort in research and resource management? First, perhaps, has been the multipurpose, often conflicting demands for this limited resource coupled with an "ostrich-like" approach of not recognizing values that would be destroyed by certain uses. Second is the complexity of these ecosystems, baffling even those who have honestly attempted to determine the best methods for *using* these areas while *preserving* them a mandate sometimes referred to as "the National Park Service dilemma."

These riparian habitats support some of the world's richest ecosystems. The "bottomlands" along creeks in Redwood National Park produce the greatest biomass (pounds of living matter/unit area) of any place in the world, even exceeding production in tropical rain forests. Studies by Johnson and Carothers published in the American Zoologist in 1974 disclosed that the highest known populations for non-colonial nesting birds in North America occur along Southwestern streams. Numerous other examples of the outstanding productivity in these scarce ecosystems occur throughout riparian literature.

Riparian areas serve as ecotones between aquatic ecosystems on one side and upland ecosystems on the other. This results in an "edge effect," defined by ecologist Eugene Odum as, "the tendency for increased variety and density at community junctions." Thus, riparian areas are commonly composed of a two-sided, complex assemblage. From one side come characteristics and organisms of the adjacent aquatic habitat (such as increased soil moisture and wetland plants), and from the other side, characteristics and organisms representative of the upland ecosystem (such as terrestrial vertebrates and upland plants). In addition, the unique environmental conditions of these riparian ecotones support many species of plants and animals that occur *only* in riparian ecosystems.

Recent studies show that numerous officially listed endangered species, both aquatic and terrestrial, are dependent on riparian ecosystems. Johnson, Haight, and Simpson recently published an analysis of habitat requirements of the 166 nesting species of birds in the Southwest Lowlands. They found that 45 percent of these species were absolutely dependent on riparian habitat and adjacent wetlands while an additional 26 percent preferred riparian to upland habitat. The loss of riparian habitat in the Southwest has directly affected almost ¾ of the nesting avian species. Continued loss of riverine ecosystems, including riparian, may lead to the extinction or significant reduction of species not currently listed by the U.S. Fish and Wildlife Service as threatened or endangered.

Our mandate clearly states that we are to perpetuate the living systems in our charge. It thus becomes the job of researchers and managers alike to work for the understanding, intelligent use, and preservation of these riparian ecosystems on National Park Service lands.

Roy Johnson is senior research scientist and leader of the NPS/CPSU at the University of Arizona. The next issue will carry an article by Dr. Johnson on the NPS resource management problems posed by the riparian systems of the Colorado River.

***Cattle graze** and discharge wastes alongside the John Day River near the John Day Fossil Beds, NM in eastern Oregon, comprising a classic scene of abused riparian habitat.*

Meetings and Symposia

Hawaiian Volcanoes NP will host a Conference on the Feral Pig, August 7, 1981. Topics will include biology, control, cultural aspects, and impacts. Only invited papers will be presented. An agenda will be available in late June through the NPS CPSU at the University of Hawaii or from the National Park.

Requests for Field Research Proposals

The Center for Field Research in Belmont, MA, together with its affiliate, EARTHWATCH, is organized to provide citizen sponsorship of field research and to encourage public understanding of science. Nancy Bell Scott, associate director of the Center, in a recent letter to Dr. William P. Gregg, Jr., of the NPS Office of Science and Technology in Washington, D.C., asked that NPS scientists be made aware of the Center's capabilities.

"Very simply," she wrote, "we support projects conducted by postdoctoral scholars whose recovery of information and data in the field can constructively employ the skills and talents of non-specialists. In 1981, we will provide funding and volunteer assistance to 70 worthy research projects in the life sciences, marine sciences, physical sciences, social sciences and humanities. We are now reviewing proposals for 1982 research."

To apply, submit a 2-page Preliminary Proposal outlining your research objectives, project dates, planned use of volunteers, and need for funds. Following favorable review, a Formal Proposal will be invited; this must precede field work by nine months.

For application guidelines and a listing of projects currently receiving support, write: Nancy Bell Scott, Center for Field Research, Box 127-BM, 10 Juniper Road, Belmont, MA 02178.

Forest ecologist *Nalini Nadkarni takes a close look at epiphyte/host tree relationships in the upper canopy of the Hoh Rainforest in Olympic National Park.*

Incident at Mount St. Helens??

Ash blackened the sky and cinders rained from a thunderous cloud. The magnitude of the volcanic eruption so far exceeded expectations that early news of the event was constructed of fragmentary, often hysterical accounts. Real knowledge of what happened that day would be years away in the learning – product of science's striving to match historic occurrence with scholarly, definitive descriptions of the process.

The event so described was not the incident at Mount St. Helens. It took place in the shadow of the San Francisco Peaks near the Grand Canyon in 1065 A.D. Archeological investigations over the decades confirm the presence of prehistoric people, who would have been struck with terror and whose total environment – including social, economic and political – would be changed by the event.

The contemporary tie-in with the Mount St. Helens eruption, already established in the minds of park visitors, has been noted and used much as set forth above, by Don Follows, team captain for the General Management/Development Concept Plan now underway at Wupatki and Sunset Crater National Monuments. These two sites were impacted by the 1065 A.D. explosions, and Supt. Henry L. Jones reports that in spite of rising fuel costs, interest is such that visitation at Sunset Crater has increased.

The 1930 act for establishing Sunset Crater NM contains language specifying that the cinder cone and its associated lavas should be preserved "to illustrate the dramatic effects of the violent eruption and aftermath upon the prehistoric people living in the area."

(For related commentary, see editorial inside front cover.)

Rainforest Canopy Research Underway In Olympic NP

By Nalini M. Nadkarni

The upper tree canopy of the rainforest is an unexplored world of both aesthetic and biological significance. Processes fundamental to forest growth and regeneration – photosynthesis, pollination, fruiting, nutrient exchange – take place high above the forest floor. With funding from the Man and the Biosphere (MAB) Secretariat, forest ecologists at the University of Washington have initiated a study of nutrient cycling within the canopies of two rainforest ecosystems, one temperate and the other, tropical.

Our two-year project concerns the role which epiphytes (plants deriving support but not nutrition from host trees) play in the nutrient dynamics of a temperate and a tropical rainforest. Epiphytes comprise a large portion of the canopy in both sites: the Olympic rainforest, on the west coast of Washington State, and the Monte Verde Cloud Forest Reserve, in Costa Rica. By focusing on how this one component of the ecosystem affects other parts, we simplify the bewildering complexity of rainforest interactions. By comparing analogous interactions in two geographically distant but environmentally similar ecosystems, we increase our understanding of some of the fundamental processes underlying rainforest dynamics.

To carry out the necessary measurements for investigating processes of within-canopy nutrient storage and exchange, longterm support was needed. Objectives of the MAB Consortium, outlined in the 1979 MAB *Bulletin,* matched almost exactly the work goals we envisioned. Their primary objectives include: carrying out basic research on structure and dynamics of tropical and temperate forest ecosystems to provide a basis of natural resource management; implementation of longterm biological monitoring in established Biosphere Reserves; promotion of international involvement of forest research and management, especially in developing countries; expansion of public understanding for forest ecosystems; and promotion of conservation as a strategy for safeguarding the genetic diversity of biota.

A 26-month proposal was submitted early in 1980. Happily, the project was funded, and field and laboratory work is proceeding in the temperate site, the Hoh River Valley of the Olympic National Park, an established Biosphere Reserve. The tropical fieldwork in montane Costa Rica will be carried out in 1982.

Progress to date includes estimation of epiphyte biomass and nutrient content to learn the magnitude of nutrients stored in the epiphyte component of the canopy. The nutrient flux in precipitation to quantify epiphyte effects as rain falls through the canopy also is being monitored. A reference collection of epiphytes is growing, and ecological interactions such as colonization rates, succession, and competition are being monitored with photographs of canopy "mini-quadrats."

Modified mountain-climbing *techniques – with ropes, harness, and Jumar ascenders – help to expand a naturalist's perceptions high above the forest floor.*

Another future plan includes interpretation of the canopy world to park visitors. A slide/tape program for use in the Olympic NP visitor station is being developed. The presentation will focus on biological interactions of canopy plants and animals, with emphasis on parallels and similarities between temperate and tropical rainforests.

Rainforest ecosystems are being recognized rightfully as valuable and unique, worthy of preservation and careful management for a multitude of reasons. Funding organizations such as MAB have made a commitment to supporting baseline ecological research on these fragile and important biomes.

(Information on MAB's programs and grants can be obtained by writing to: U.S. MAB Secretariat, U.S. Department of State, IO/UCS SA-2, Washington, D.C. 20520).

Yellowstone Elk: Some Thoughts On Experimental Management

Editor's Note: An experimental approach to understanding and dealing with the population dynamics of large grazers and the nature of vegetation-herbivore equilibria in parks is the recommendation of Doug Houston, NPS research biologist stationed at Olympic NP in Washington. Houston, who is preparing his 13-year landmark study of the Yellowstone elk for publication, here condenses some of his findings that relate specifically to management of in-park ungulate populations, both native and exotic, with particular attention to the significant differences between ecological carrying capacity and the management implications which that difference exposes.

By Douglas B. Houston

The Elk

Elk are the most abundant large grazing mammals in Yellowstone National Park. Those wintering on the Yellowstone River in and adjacent to the park have become known as the northern Yellowstone herd. Management of this largest single ungulate population in the park has long been beset by controversy. Recent concerns center upon the amount of human interference required, if any, to maintain vegetation-elk equilibria in the park. One view – a laissez-faire approach to park management – counts upon natural regulatory processes to produce acceptable equilibrium states. The contrasting management view is that pristine relationships have been destabilized by modern man, and that interference now is required to impose vegetation-herbivore equilibria more in keeping with park objectives. In practice this interference has involved periodic reductions in ungulate numbers. Both approaches have been tried with the northern Yellowstone elk.

What Was Done

The nature of existing vegetation-elk relationships on the northern winter range was examined from 1970-1979, to determine if population reductions are necessary in the park (most of these elk winter in the park, but one herd segment winters outside the boundaries and is hunted. Another aspect of the study was an attempt to reconcile these two different management objectives). Our approach was to set up a series of interrelated research hypotheses subject to testing, modification and rejection. The test of whether or not progressive "range deterioration" was occurring became far more complex than imagined initially. A sound historical perspective on changes in elk numbers and in the vegetation was a necessary first step. This led to studies of climate, fire history and human activities in the park. The elk population was examined for evidence of density-dependent negative feedback controls (described below) on population size, and for evidence of limitation through extrinsic forces such as human predation or resource levels.

Testing hypotheses in field studies is difficult at best, and doubly so in national parks where experimental manipulations usually are prohibited. Some hypotheses were tested using the method of successive approximations, where data are continuously examined for consistency with the research hypothesis.[1] Hypotheses are modified or rejected as inconsistencies appear. However, in the case of northern Yellowstone elk, hypotheses could be tested in a somewhat more experimental manner.

The west face *of Mount Everts in Yellowstone Park as it appeared in 1871 (upper) and in 1971. Bighorn sheep, mule deer and elk winter on the area. The bare-appearing slopes occur in the earliest scene, are heavily grazed, and appear to be little changed during the past century.*

Human predation had reduced elk numbers in the northern herd from around 12,000 to 4,000 between 1955-1968. A moratorium on reductions went into effect in the park in 1969, and numbers increased again to around 12,000. These manipulations were viewed as an experimental perturbation, useful for testing research hypotheses and for providing insight into ecosystem dynamics.

What Was Found

1. An extensive review of historical records shows, in contrast to earlier interpretations, that Yellowstone has served continuously as winter range for the northern herd since at least the 1870's. The present distribution and densities seem best interpreted as a remnant of a once far greater biomass of ungulates that occurred in the region, rather than as an artifact created by establishment of the park.

2. Examination of the dynamics of the elk population shows strong density-dependent relationships, i.e., the percentage of mortality (particularly of young) increases, and the reproductive rate decreases as the population rises. The population is then considered to be "regulated" because natality and mortality show negative feedback from population density. The population can come into equilibrium with the park's vegetation through these density-dependent processes. The level of this equilibrium, the "ecological carrying capacity," is the appropriate carrying capacity for a native ungulate in a national park. But this is a very different, higher capacity than that for which wild and domestic ungulates are managed outside parks. Outside parks, most populations are managed for a maximum sustained yield and are maintained at an "economic carrying capacity" that is often about one-half of ecological capacity. Managers and biologists have not always recognized these different definitions of carrying capacity.

3. Studies of growth, condition and behavior suggest that the overall elk population is limited by the quality and quantity of winter forage, but that human predation outside the park modifies this resource limitation. Intraspecific competition along dominance hierarchies affected access to scarce food resources.

4. Evidence from studies of the vegetation did not support an interpretation of progressive pathological range deterioration. (The vegetation studies included rephotographing over 300 early scenes of the vegetation and analyzing 308 range plots measured over the 1930-1978 period.) Interestingly, the historic photos showed that range sites considered to be "overgrazed" by conventional criteria had the same appearance over a century ago, before the park was established. The departures from pristine conditions of vegetation on the winter range were limited and seemed to result primarily from fire suppression. In short, the elk effects on vegetation did not appear to have exceeded those expected from a population near ecological carrying capacity in a stable vegetation-ungulate system.

5. Severe inter-specific competition between elk and associated large herbivores (mule deer, bison, moose, bighorn sheep, pronghorn) could not be demonstrated. Differences in distribution and food preferences permit these less abundant species to persist in the presence of much larger numbers of elk. The management philosophy of maintaining arbitrary "balances" among ungulate species by reductions of one to favor another seems unnecessary and inappropriate in the park.

The major changes *in the vegetation of the northern winter range appear to have resulted from a reduction in natural fires, as indicated by this scene photographed in 1885 and in 1970. Big sagebrush and Douglas fir have increased on a former bunchgrass range. Aspen (above boulder in original) has declined.*

What Was Recommended

Some changes from the pristine ecological relationships have indeed occurred in Yellowstone National Park. However, the park still is remarkably intact

ecologically, and the potential for further restoration is very great. Management recommendations were aimed at compensating or correcting for the influence of modern man on ecosystem processes. Major recommendations include:

a. Expand the park's fire management program to include the rest of the winter range in the park and implement a limited program of experimental prescribed burns.

b. Do not reduce the numbers of elk or of any other large ungulate in the park to alter the present vegetation-ungulate equilibrium.

c. Develop innovative strategies for hunting those elk herd segments that winter outside the park. This will require close cooperation among management agencies. Even though elk hunting outside the park alters the dynamics of the hunted herd segments, it seem possible, through sensitive management, to minimize effects upon the park.

d. The gray wolf should be restored to the park.

How recommendations are to be implemented is as important as *what* was recommended. All manipulative management of park biota should be regarded as essentially *experimental.*[2] This means that hypotheses to be tested, procedures to be used, and criteria to reject or reformulate hypotheses, should be stated clearly in advance. The information obtained from management programs should be reviewed frequently for consistency with the hypotheses being tested.

The experimental management approach is still needed for understanding both the population dynamics of large grazers and the nature of vegetation-herbivore equilibria in parks. I generally *do not* advocate manipulating wild populations of native ungulates below ecological carrying capacity in parks that are complete ecological units. However, if park managers have reason to suspect that ungulate numbers are "too great," and reductions are being considered, then an experimental approach is clearly indicated.

An experimental approach to management of "exotic" herbivores, e.g., goats in Hawaii, burros in wherever, mountain goats in Olympic, and wild boars in Great Smokies, also should be useful to managers. A well planned, small scale experimental reduction can provide a great deal of information about the statistics of population growth, i.e., the ability of a population to compensate for increased removals. This information is then used to determine the magnitude of the removal problem, to appraise the effectiveness of control strategies and to calculate costs.[3] Beyond the immediate needs of park managers, an experimental approach to the control of exotic species could contribute substantially to our understanding of the ecology of these large mammals.

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[1] *Poore, M.E.D. 1962. The method of successive approximations in descriptive ecology. pp. 35-68* ***In*** *J.B. Cragg, (ed.) Advances in ecological research, Vol. 1 Academic Press.*

[2] *Sinclair, A.R.E. 1979. Dynamics of the Serengeti ecosystem. pp. 1-30.* ***In*** *A.R.E. Sinclair and M. Norton-Griffiths, (eds.) Serengeti: Dynamics of an ecosystem. Univ. of Chicago Press.*

[3] *Caughley, G. 1977. Analysis of vertebrate populations. John Wiley and Sons. 234pp.*

2 Histories Recommended

Don Field, associate director for science and technology in the Pacific Northwest Region, has recommended to CPSU libraries in his region the acquisition of two books about the history of the National Park Service: Alfred Runte's **National Parks: The American Experience,** and Conrad Wirth's **Parks, Politics and the People.**

The Runte book, published in 1979 by the University of Nebraska Press, examines the different rhetoric that was used, over time, to justify the National Parks. Field found weaknesses in the Runte book where he deals with the decades of the '50's and '60's – a deficiency that is remedied in Wirth's detailed account of the Mission 66 program that developed in the early 1950's and culminated in 1966.

"I recommend these two books for your library," Field said, because "as scientists we should know something about the human history of the National Park System and the National Park idea."

WASO PUBLICATIONS

Three large mammal studies and three works on remote sensing are nearing publication by the WASO publications division. *Grizzlies of Mt. McKinley* is in paste up, and two others are ready for paste up – *Ecology of the Carmen Mountains White-tailed Deer* and *Social Behavior and Ecology of the Collared Peccary in Big Bend National Park.*

Also being pasted up (as of April 1) are *Remote Sensing: Aerial and Terrestrial Photography* (Handbook Supplement No. 7), *Remote Sensing: Applications of Remote Sensing in the North American Central Lowlands* (Handbook Supplement No. 6), and *Remote Sensing: Multispectral Analysis of Chaco Canyon and Bandelier National Monument* (Handbook Supplement No. 5).

Lesser-Known Areas of the National Park System was released for printing and binding, as also were *Archeological Surveys of Chaco Canyon NM* and *Contributions to Gran Quivira NM, Beach Ridge Archeology of Cape Krusenstern* was released for composition. *Archeological Overview of Saguaro NM* was being designed, and *Archeological Investigations of Antelope House, Canyon de Chelly NM,* was awaiting galley revision.

Information on these publications may be obtained from Napier Shelton, NPS, DI, Washington, D.C. 20240, or FTS 523-5127.

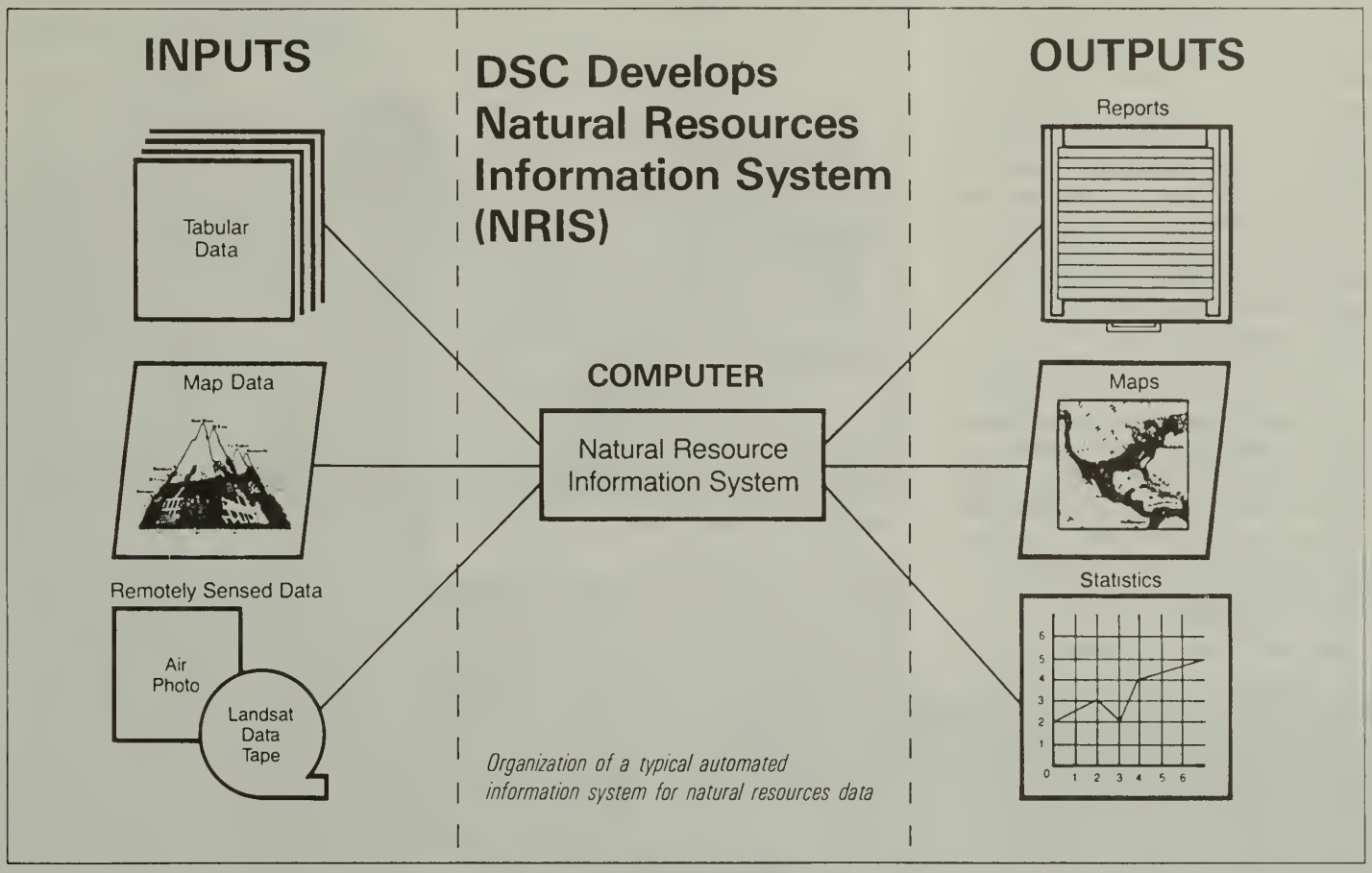
WASO Publications

Monograph Examines Potomac Island Exotics

A solid new entry in the scientific monograph series out of the Washington office is **The Impact of Three Exotic Plants on a Potomac Island** by Lindsey Kay Thomas, Jr. Thomas examines Japanese honeysuckle and English ivy, which are destroying the forests of the upper elevations on Theodore Roosevelt Island – a low lying island in the Potomac in Washington, D.C., and the role of European yellow iris in changing the marsh area of the same island.

The study identifies disturbance as the key to entry for all three species, even in a successional stage. The disturbances in all cases were products of human activity and have resulted in biological explosions on the island. "One of the greatest impacts of man on the environment," Thomas concludes, "is his introduction of exotic species into environments that he has disturbed. These introductions often trigger a sequence of events that counter the goals or best interests of man himself."

On Theodore Roosevelt Island, Thomas finds, "the planned and unplanned activities of man, both before and since the area became a park, have set in motion biological forces which are destined, unless countered, to destroy the upland and floodplain forests and the marshes." The final community there, he predicts, will be dominated by English ivy; the only forests on the island will be those of the present swamp, and they will have increased in size due to the destruction of the marsh by the European yellow iris.



By Maurice Nyquist

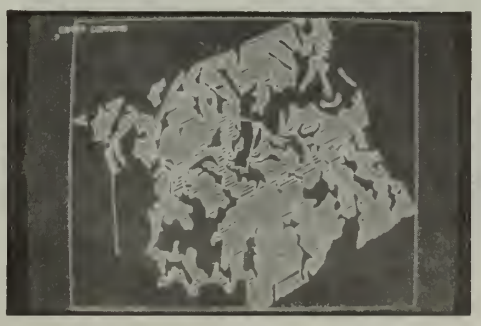
A major hindrance to efficient NPS management and planning has been lack of pertinent data. Too often the data relied on have been out of date, not site specific, incomplete, and/or gathered "after the fact" by costly contracting. Remote sensing and computerized data base management techniques for acquiring and analyzing resource data can circumvent this problem, providing accurate data in a timely, cost-effective manner.

The Remote Sensing and Science Sections at the Denver Service Center have been using these techniques for five years in many projects in most regions of the Service. These sections have assembled the skills, staff, and equipment required for an operational *Natural Resources Information System.*

The basic NRIS objectives were to provide a functional management tool that could quickly and cost effectively gather and analyze information needed by the Park Service. Remote sensing technology serves these objectives by: (1) providing *relevant* and *accurate* information *quickly* and at *low cost,* e.g. most projects are completed within a few months with mapping accuracies of 90 percent or better, and depending on the techniques used, total project costs range between 5 and 50 cents per acre; (2) *flexibility,* in that it is suited for many types of application at nearly any level of detail, (it can provide both regional and detailed site specific information

SIMPLE EXAMPLE *of output from NRIS (above): Road network (dashed lines) overlaid by 100 year flood plain (shaded band) shown on screen of graphics display terminal.*

MORE COMPLEX *example (below) shows polygons of two different soil types being evaluated.*



for an application such as vegetation, geology, land use, potential habitat for wildlife, fire models, etc.); and (3) the *replicability* of the technique, especially useful for *monitoring* and *change detection* studies. Computer technology is capable of handling large volumes of complex data quickly and inexpensively to give analysis not possible by other methods, it can integrate and update information which can be readily accessed from remote sites. Thus the combined attributes of remote sensing and computerized information management, functioning in concert, give the Natural Resources Information System much greater capabilities than either functioning independently.

The most immediate benefits to the Service are the NRIS responses to basic needs identified in the State of the Parks 1980 Report, such as preparation of a comprehensive natural resources inventory, establishing accurate resources baseline data for monitoring and change detection, and identifying, documenting and quantifying internal and external threats to the parks. This data can be generated and used for various levels of planning, resources management, interpretation, operations and budget formulation. In addition, for little cost (approximately $10,000 for a graphics terminal) individual parks could directly access the data base for day-to-day management needs once the basic resource themes have been mapped and entered into the computer.

The use of remote sensing to gather information relies on many different techniques, such as Landsat

satellite computer tapes or imagery (pictures) aerial photos of various types (B/W, color, or color infrared) and scales, and such exotics as microwave or side-looking radar. The operational program of the Remote Sensing Section primarily relies on photo-interpretation of aerial photography or Landsat imagery, although several demonstration projects with NASA and the EROS Data Center have used computer implemented processing of Landsat digital tapes to perform resource mapping and analysis at Shenandoah, Death Valley, Olympic, Big Thicket, Lake Mead and Everglades.

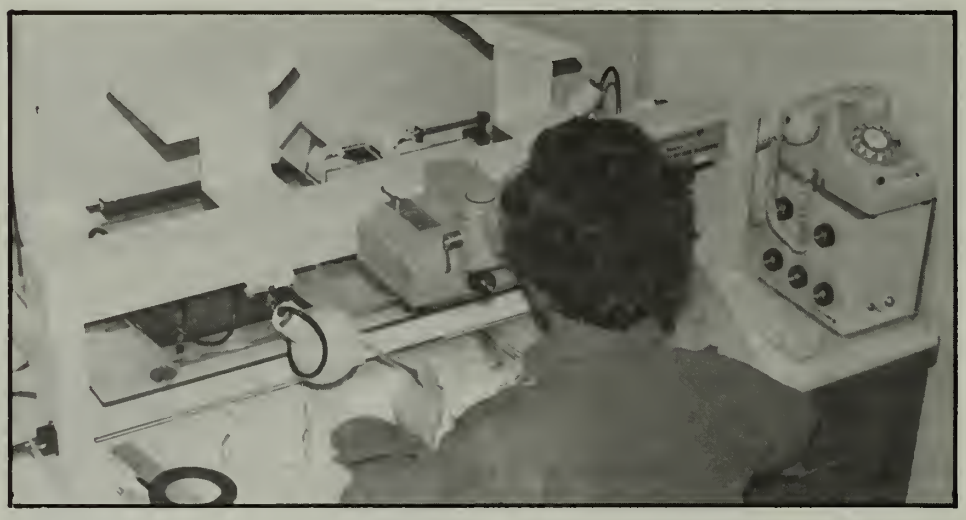
Landsat project results have been highly successful. For example, a very useful and accurate 21 class vegetation and landcover map was developed for the Olympic peninsula. And, because the data were in computerized format the vegetation map was easily converted to a fire hazard/behavior map, to be used for fire management planning. These same data were again manipulated to produce a map of potential habitat for the Spotted Owl, a threatened species.

More typically, the Remote Sensing Section photo-interprets aerial photos and transfers the desired themes (e.g., vegetation, landuse, geology, etc.) to a controlled map base. This can be used as it stands for the desired resources management, planning, or interpretation activity. In many instances, however, the Science Section enters the other sources of data into the computer to form a digital data base for additional analyses.

A recent example is the work for Acadia NP. The Remote Sensing Section is preparing detailed vegetation and landuse maps which the Science Section is digitizing for computer analysis in fire and wildlife management and planning. On a much larger scale, the Science and Remote Sensing Sections are developing a computerized data base for the entire Upper Delaware River Study which includes vegetation, geology, landuse, soils, land ownership, roads, utilities, political boundaries, flood plains and other themes. The analysis performed such as compositing, proximity searches, length or area calculations and several other types of analysis will be used to aid in developing planning alternatives, feasibility/suitability determinations, and impact assessment.

The comparison between an artist's pallet and the NRIS forms an appropriate analogy. The artist's pallet has a few basic colors which the artist can use to paint nearly any type of picture. Remote sensing can provide the basic resource themes (i.e., the basic colors on the pallet) and these themes can be manipulated many different ways to produce the desired new maps or analysis (the artist's picture). Just as the quality of the artist's picture is dependent on the artist's skill, the quality of the NRIS products is dependent upon the skill of the people working with the NRIS (i.e., knowing the correct types of data to bring together and asking the right questions) as well as the quality of the data (i.e., colors) put into the system.

DIGITIZER *tablet and graphics display terminal (by which data is digitized to form a digital data base for various kinds of analysis.)*



STEREO ZOOM *transfer scope, whereby photointerpreted themes are transferred to controlled map base.*

If you have questions about the use of the DSC NRIS for your individual management needs, please call me (Dr. Maurice Nyquist, Chief, Remote Sensing Section) for information about resource mapping and Dr. Harvey Fleet, Chief, Science Section, for information about digital data management, at the Denver Service Center. (303-234-4527, or FTS 234-4527).

Editor's Note: In an excellent article, "Remote Sensing: Tool for the Park Manager," in ***The Courier*** *(NPS Newsletter) October 1980, Mary V. Maruca of the WASO Anthropology Division wrote:*

"Remote sensing is not a panacea for resource management problems, but it is an essential element through which to gain an understanding of just what resources a park actually protects. It is a tool for the superintendent, the archeologist, the natural resource manager, the interpreter. The park manager, the researcher, and the remote sensing specialist must work hand in hand as a team to develop a solid resources basic inventory on which to preserve the parks of the future."

PHOTOINTERPRETER *does his job on the zoom stereoscope.*

Plant Research at Haleakala

Endemic silversword *is the "trademark" of Haleakala NP About 40,000 of these remarkable plants persist, although their range has been reduced by goat browsing. Silverswords grow vegetatively for about 20 years, then flower and die. This one should be flowering within a few years.*

By Lloyd L. Loope

Haleakala is not among the better known national parks to the general public, but ranks second to none in botanical riches. Located on the Hawaiian island of Maui, the park includes the erosional crater of a huge dormant volcano with elevations of 3800 - 10,023 feet and the adjacent Kipahulu Valley which descends to the coast. First established as the Haleakala Section of Hawaii National Park in 1916, it was given independent status in 1961.

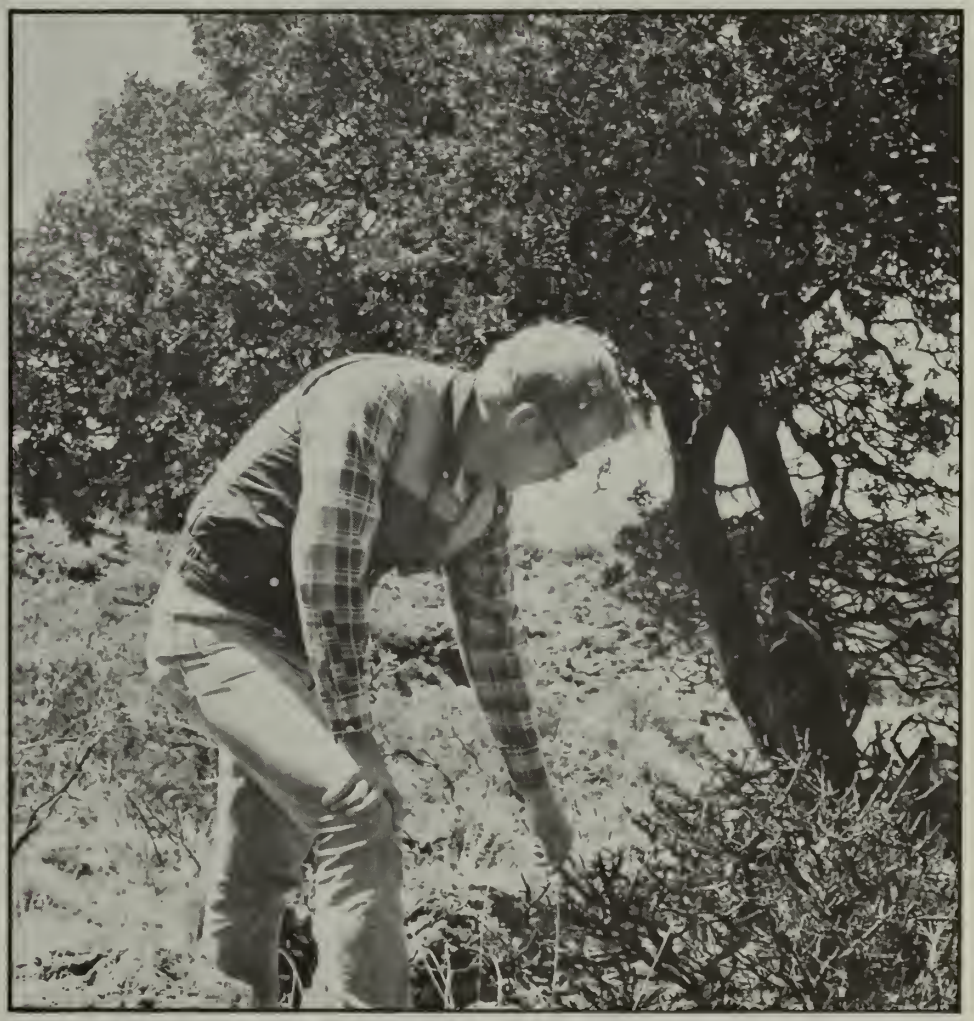
Haleakala is probably best known for its famous silverswords, but this bizarre plant is only one of hundreds of Haleakala species confined to the Hawaiin Islands and dozens restricted to east Maui. Unfortunately, Haleakala has too often been treated as simply a grand geological phenomenon and the destruction of its biological riches accepted as an unavoidable evil. It has long been well known that feral goats and pigs are destroying the vegetation, but park managers have been largely frustrated in their efforts to confront the problem. Although a concerted effort at goat reduction by hunting has somewhat alleviated goat browsing pressure, hunting alone cannot control the large reservoirs of these animals that exist on adjacent State and privately-owned lands. Successful goat impact control and restoration efforts can be accomplished only by fencing out this external source. The magnitude of this task has intimidated park managers until recent years.

Over the past decade, fencing has proven itself an effective strategy for reducing goats in Hawaii Volcanoes NP. The current Haleakala administration recognized the need for a concerted resource management and research effort and began reorganizing priorities and shifting funds into these activities in 1975. The University of Hawaii CPSU became actively involved at Haleakala and superbly documented how much there is yet to lose. A research lab and quarters to support research and resource management projects were created from an old military barracks. Sierra Club volunteers beginning in 1978, have constructed 4.5 miles of fence. Full-time research and resource management positions were established in 1980. A major fencing program for Haleakala now ranks at the top of the NPS construction program for 1983.

I came to the scene at Haleakala last fall to fill the newly established research position. My research is designed to assist in restoring native vegetation and flora once the browsing pressure of goats is removed. Examples of the types of problems which exist include the following: Mamane, once a major component of the high elevation vegetation, is a favorite food of feral goats and is "highlined," with no reproduction in most places where it occurs. Although it produces abundant seed, there is no indication that successful seedlings are being produced, even within goat exclosures. Yet healthy seedlings can be readily produced under greenhouse conditions. We will try to resolve the question of how to get successful mamane regeneration.

Haleakala sandalwood, a species endemic to the portion of Haleakala above 5000 ft., has been reduced to a few hundred individuals. Goats have "highlined" sandalwood virtually wherever it occurs. Rats are believed to eat sandalwood seeds, so that seedling establishment may not occur even in the absence of goat browsing. We are attempting to determine whether sandalwood can reproduce from seed when seeds are protected from rats by wire mesh exclosures.

Dry forest on the southern slope of Haleakala is composed of nearly 50 tree species, many of which have become very rare throughout their ranges in



Haleakala sandalwood *occurs nowhere in the world except above 5000 feet on Haleakala. Goat browsing is a major factor contributing to its decline. The shurb in the foreground is kept in a hedged condition by goats. The mature tree in the background exhibits the "highlined" form, so typical of the species under current conditions.*

Hawaii. These have not been able to reproduce for many years because of browsing by cattle and goats. Even if browsing pressure is removed, severe competition from the exotic Kikuyu grass may suffice to prevent reproduction. Rat predation of seeds and/or other yet undiscovered factors may stand in the way of reproductive success for some species. We will attempt to find out the requirements for reproduction of dry forest species. We will also try to determine what losses and range reduction of dry forest species have occurred in the Kaupo Gap area of Haleakala, with the hope of eventual restoration.

Haleakala silversword once had a much more extensive range on Haleakala than now. Goats browse off these rare plants, so that they persist only in areas of very sparse vegetation on otherwise barren cinder cones which are seldom frequented by goats. With the drastic reduction in the goat population that fencing will afford, silversword may be enabled to occupy its former range. How precisely can we define its former range? How quickly can it be expected to reestablish in formerly occupied sites, following goat removal? Would careful artificial scattering of silversword seed in suitable habitats where it is believed to have once occurred be a desirable management practice? What is the status of silversword populations currently? Other rare species, many of them endemic to Haleakala, require answers to questions similar to those for the silversword. My research will build upon findings of investigators of the University of Hawaii CPSU and others, but will only represent a beginning at finding answers to crucial long-term problems involving preservation of the Hawaiian biota in national parks and elsewhere. These problems are difficult ones, but the rewards of success are great because of the outstanding significance of Hawaiian biota in illustrating evolutionary principles.

Lloyd Loope is research biologist at Haleakala NP, Box 537, Makawao, Maui, HI 96768.

★ ★ ★

From William T. Duckworth, personnel officer for the Alaska Region, this bulletin announces other science-related positions newly filled: Glacier Bay park ranger (resource management), Gary Vequist; Bettles cultural anthropologist, Ray Bane; and Alaska regional office appointees Gary Ahlstrand, research ecologist, and Francis Singer, wildlife biologist.

★ ★ ★

PEOPLE AND PLACES

Larson Tackles New Job

Jim Larson

Jim Larson, whose NPS career has had him filling slots all over the Park System, is currently settled (but by no means "at rest") in Seattle, as chief of biological services for the Science & Technology Division in the Pacific Northwest Region.

A North Dakota native, Larson earned his B.S. in zoology at the University of Wisconsin, his M.S. in forest ecology at the University of Washington. Starting in 1959, Larson has been a park ranger at Mt. McKinley NP, a park naturalist at Rocky Mountain NP, chief park naturalist at Haleakala NP, staff biologist in the chief scientist's office in Washington, D.C., regional chief scientist of the Southeast and of the Midwest Regions, and most recently chief of the Alaska Area Division of Natural Resources.

His research activities include a life history study of the Hawaiian dark-rumped petrel in Haleakala Crater and the ecological study of lodgepole pine at North Cascades NP. He co-authored the National Park System Plan – Part II (Natural History) and prepared a national park system plan (natural history) for Greece.

Jim's boss, Don Field, has expressed great enthusiasm for the appointment, and is showing his appreciation by burying Larson under a mountain of administrative work. Just before he went under for the third time (when the picture was taken) Jim was still smiling.

Lovaas Closes The Circle

Allan Lovaas is back in the north country again.

A wildlife biologist with a master's degree from Montana State in Bozeman, Lovaas arrived in Anchorage in March to pick up the reins as chief, division of natural resources for the Alaska Region – the job previously held by James Larson.

Lovaas' prior assignment was five years as chief scientist for the NPS Midwest Region out of Omaha, Nebraska. Before the Omaha berth, Lovaas worked six years at Wind Cave PN on bison, elk, antelope and prairie dogs. Previous to his National Park service, Lovaas put in 10 years with the Montana State Fish and Game Department, and that stint was preceded by two years of work for the Canadian Wildlife Service out of Edmonton – mostly in the Canadian National Parks and the Yukon Territory.

"In a way," said Lovaas, "I've come full circle . . . back to the North Country again."

New Faces in Hawaii Park

A new face in the ranks of Western Region scientists is that of Charles P. (Chuck) Stone, research scientist at Hawaii Volcanoes National Park. Before joining the National Park Service on Nov. 4, 1980, Chuck spent 16 years working with the U.S. Fish and Wildlife Service.

He earned his B.S. degree at the University of Minnesota, his M.S. at Colorado State University and his Ph.D. at Ohio State. His research areas are animal damage control and avian ecology, particularly nongame birds and raptors.

Most recently, Chuck was for five years chief of

Charles P. (Chuck) Stone

the section of Wildlife Ecology on Public Lands at the Denver Wildlife Research Center, where he also served two years as assistant director and before that was research biologist with bird damage control.

The following story, submitted just in time for this issue of *Pacific Park Science,* suggests that no grass (exotic or native) will grow under his feet at Hawaii Volcanoes.

Research Focuses on HAVO Exotics

By C. P. Stone

The seemingly impossible task of managing for precontact Hawaiian ecosystems with the hodgepodge of introduced plants and animals (yes, even in national parks), presumes that we know what precontact systems were like. It turns out, in many cases, we do not.

What we do know is that, by definition, introduced (exotic) plants and animals were never here before man. We also know that exotic mammals, birds, invertebrates, plants, and diseases have had, are having, and probably will continue to have tremendous impacts on native species and systems.

Thus, a logical management strategy seems to be to try reducing impacts of exotics in some situations in the hope that natives eventually will benefit. Research in Hawaii Volcanoes NP is geared toward ultimately providing information about such situations and methods of putting exotics at a disadvantage.

Building upon excellent past efforts of Service scientists such as C. Van Riper on avian diseases and D. Mueller-Dombois on plant ecology, current Hawaii-based service research scientists D. Gardner, L. Loope, and I (Stone) are working on other important aspects of the exotic-native problem. All are affiliated with the CPSU at the University of Hawaii, headed by C. Smith, and are supervised by D. Fenn, WRD Chief Scientist. Gardner is stationed in Honolulu and specializes in plant diseases and exotic plant control. Loope is stationed at Haleakala and concerned primarily with native plant ecology. I am stationed at Hawaiian Volcanoes and working primarily on impacts and ecology of exotic vertebrates. All three (plus Smith) are responsible for research in Haleakala and Hawaiian Volcanoes, both of which recently were designated Biosphere Reserves.

As the most recent addition to the NPS research team, I will be placing my initial research emphasis on ecology and impacts of feral pigs, mongooses and rats. These vertebrates are responsible (with introduced plants, invertebrates, and diseases) for the most intensive and widespread perturbations to Hawaiian ecosystems.

The challenge is to learn enough about each in different situations to be able to recommend efficacious methods to favor native species and systems at the exotics' expense. Such methods may involve exclusion by fencing and other means; chemical repellents, attractors or toxins; hunting and trapping; biocontrol, or various combinations of these.

Research on the mongoose, thought to be a primary deterrent to reestablishment of self-sustaining Nene (Hawaiian goose) populations in Hawaii Volcanoes, already is underway and will be reported on in a future Bulletin. Planning for establishment of vegetational transects to monitor feral pig abundance and distribution, determine effects of pig management actions in Hawaiian Volcanoes, and provide a baseline for future testing and recommendations already has begun.

Through combined efforts of researchers inside and outside the Service, better understanding of exotic organisms and their impacts on complicated and important Hawaiian ecosystems should be reached. Recommendations on how to minimize impacts of exotics should provide managers with important ways to produce less altered systems for future generations.

Dan Allen

Skill Expansion Supported

Dan Allen, resource management specialist with the North Cascades NPS Complex, began in the fall of 1980 a two-year training program toward a master's degree in forest resources from the University of Washington, with emphasis on fire management. Don Field, associate director for science and technology for PNR, announced support for Allen's training as part of the overall effort to expand the skills of the region's resource management cadre. "For a science program to be truly successful," Field said, "the application of knowledge acquired must be a consistent priority."

Allen has been at North Cascades for three years; before that he was a district ranger in the Everglades doing backcountry exotic plant control (mainly water hyacinth) and fire management. He sees his training as a personal step toward more professional resource management, especially in the field of his particular interest – natural fire and the possible use of prescription fire at North Cascades. His goal is, "more complete understanding of total interrelationships and a wider frame of reference for the management tasks we are performing."

Regional Highlights

CPSU ANNUAL REPORTS

The 1980 CPSU Annual Reports for the Pacific Northwest Region for the first time reflect both the biological and sociological research activities of the units. Distribution has been made throughout the region, and additional copies are available from the Association Regional Director for Science and Technology, 601 Fourth and Pike Bldg., Seattle, WA 98101.

Denny Fenn, Western Region Chief Scientist, announced a shift in that region's bienniel CPSU report schedule to January and June. The June reports, one for each of the four states (California, Arizona, Nevada and Hawaii), will contain only progress reports on the contracted research projects. The January reports will consist of reports on all 48 research scientist projects and one-page reports on all private research in parks as well as progress reports on all contracted research. These reports can be had from Western Region headquarters, 450 Golden Gate Ave., P.O. Box 36063, San Francisco, CA 94102.

The Alaska CPSU report was published in January and reported in the Winter 1981 issue of "Pacific Park Science."

OSU/CPSU Reports

Two fairly recent Reports now available from the Oregon State University CPSU (Corvallis, OR 97331) are **"Foraging Ecology of Prairie Falcons During the Nesting Season, Lava Beds NM,"** by B. Haak and R. L. Jarvis, and **"Coyotes and Mule Deer at John Day Fossil Beds NM: A Management Report,"** by Brad Griffith.

Haak and Jarvis concluded that home range size of prairie falcons may have been underestimated in the past (falcons in this study utilizing an area that averaged 388.5 km2 in size) and suggested that special consideration be granted by prairie falcons in management plans – cliff nest-sites and foraging areas being areas of intensive use that are critical to falcon nesting success.

The Griffith study considers both resident and migratory mule deer populations, their numbers, distribution, and area utilization, and coyote population characteristics, patterns of predation losses and food habits. In both cases, management recommendations begin with "no active control program is warranted at this time." Continued monitoring is indicated, however, and Griffith delineates the information needed and the rationale for collecting it.

Regional Highlights

Predator Prey Model Clarifies Research Needs at McKinley

Three levels of research priority, keyed to an adaptive management approach, emerge from the University of Idaho CPSU Report "A Conceptual Simulation Model of Moose-Wolf-Habitat Interactions at Mt. McKinley National Park" by R. Gerald Wright.

A major objective of the study was to synthesize past data in a systems framework, establishing priorities as to what factors should be monitored and measured on each species, and outlining the development of a long-term integrated wildlife research program. Specific objectives included:

1. compiling, condensing and synthesizing information on the components of the biological system;
2. looking at interactions among these components;
3. developing conceptual models of the system based on these data, and
4. using the knowledge to evaluate individual components in terms of their importance to the system and to determine the areas where information gaps are most critical to sound management.

Priority 1 level needs include a better understanding of the age structure and sex ratios of the moose populations, development of an optimum procedure for doing annual or seasonal counts of ungulate species, better understanding of the rate of predation on newborn moose calves and a more thorough knowledge of the role of fire as a mechanism for improving habitat quality and forage quantity for moose.

Priority 2 level needs deal with the role of human disturbance as an influence on moose, development of fuel loadings model for use with burning indices and validation of the model with data on fire history, and the effects of past use by moose on forage quality and quantity,

Priority 3 level research needs included the effect of climatic factors on the quality of forage in the park, disease as a factor in moose mortality, the influence of human disturbance on wolf predation, the influence of human harvest and poaching on park wolf populations, and the role of density and competition in determining moose movement and habitat use.

Copies of the bulletin are available from the University of Idaho CPSU, College of Forestry, Wildlife and Range Sciences, Moscow, ID 83843.

ON BEING IN MOUNT RAINIER NATIONAL PARK

Mt. Rainier National Park is a nice place to be.

'Flip-Sheets' Carry Management Message

A cheaply-executed, tightly written, eye-catching little brochure with an intriguing "other side of the coin" approach to park interpretation is performing an important public relations job for Mount Rainier National Park.

Brainchild of Glenn Hinsdale (on PNRO'S interpretive staff), the single-pager carries an upbeat interpretive message on one side and details major threats to the park on the other. As Glenn said, "The writing had to be tight and spare without being terse, and the heft and appearance of the thing had to say it was worth reading." The real message that comes through the sweetness and light is that parks decide priorities in terms of the resources that management has to allocate. It's a winsome whisper, not a bare-knuckle bludgeon and all for a rock-bottom cost.

Olympic Elk Studies Reports Published

Two Roosevelt elk studies in Olympic National Park, published this spring by the Oregon State University CPSU, contribute to the basic knowledge needed for management of this important ungulate population. "Status of Elk Populations and Lowland Habitats in Western Olympic NP," by Kurt Jenkins, found that no management of populations or winter ranges is warranted for elk at this time. Forage conditions would seem to have improved since the 1930s' studies (conducted by J.E. Schwartz) and browse pressure has decreased. "Elk and vegetation in Olympic NP are probably at equilibrium densities and further changes should not occur in the herbivore-vegetation complex in the near future," the report found. However, six specific recommendations for monitoring and researching the on-going elk/vegetation relationship were put forth in the interests of responsible management.

"Roosevelt Elk of the Hoh Valley" by Jenkins and Edward Starkey, followed the movements and habitat use of cow elk in the Hoh Valley to assess the influence of land management practices outside Olympic NP on "park" elk and provided baseline information on the behavior of undisturbed elk in old growth forests. Little influence by forest and wildlife management practices occurring outside the park was found. The primeval condition of elk on the Olympic Peninsula was seen as providing unique opportunities for research.

Both reports are available from the OSU/CPSU, School of Forestry, Oregon State University, Corvallis, OR 97331.

The Crater Lake NP visitor traffic pattern study by Bo Shelby, reported in the Winter 1981 issue of *Pacific Park Science,* also is now available from the OSU/CPSU as a report.

The February 21, 1981 issue of **The Southwestern Naturalist** carries an article by R. Gerald Wright and George M. Van Dyne, "Population Age Structure and Its Relationship to the Maintenance of a Semidesert Grassland Undergoing Invasion by Mesquite." Wright is with the University of Idaho NPS/CPSU, College of Forestry, Moscow, ID 83843; Van Dyne can be addressed at College of Forestry and Natural Resources, Colorado State University, Fort Collins, CO 80523.

Fort Spokane Rehab Alternatives Given

"A Vegetation-Rehabilitation Program for the Parade Grounds at Fort Spokane, Coulee Dam, NRA," by Craig Gehrke, Bob Kinucan and R. Gerald Wright, is now available from the University of Idaho CPSU, College of Forestry, Wildlife and Range Sciences, Moscow, ID 83843.

The report outlines a program designed to restore the plant community on the 17-acre flat plateau overlooking Lake Roosevelt to a type more closely resembling historic conditions, reducing long-term maintenance costs and fire hazards, and allowing better visitor use. Summary information is given on the characteristics of the different annual weeds and grasses, the use of herbicides and controlled fire, seedbed preparation, and seeding methods and types. The impacts of several alternative techniques are evaluated and a recommended program outlined.

INFORMATION CROSSFILE

SCIENTIFIC AMERICAN carries in its April 1981 issue an article on "Filter-feeding Insects" by Richard W. Merritt and J. Bruce Wallace, the gist of which is that underwater filter-feeders of three orders play a role in opposing the tendency of ecological systems to lose organic matter downhill. Excellent micrographs and drawings accompany the text, which describes in great detail the life cycles and feeding mechanisms and habits of examples from all three orders of insect. Aldo S. Leopold is cited for his suggestion that the continuity and stability of upland communities depend on life forms storing nutrients and organic matter and participating in other processes that retard the downhill trend all materials take in the course of natural processes. The authors conclude that although filter-feeding insects utilize only a small portion of the passing organic matter, they "convert that proportion into organic matter of a more complex form and with higher food value" – namely, their own bodies. These bodies serve as food for life higher up the food chain. "Thus," say the authors, "they act to retard the dominant downhill movement of organic matter by both retaining it and altering it."

Jon F. Haman, Denver Service Center, with William J. Todd and Dale G. Gehring of Technicolor Graphic Services, Inc., EROS Data Center, Sioux Falls, SD 57198, authored a paper on "Landsat Wildland Mapping Accuracy" in **Photogrammetric Engineering and Remote Sensing,** April 1980 (pp. 509-520). The research examined three principal categories of classification error in Landsat data with regard to land-cover classification for the Shvwits Plateau region of Lake Mead NRA. Construction of contingency tables revealed that there was less confusion between aggregated (more generalized) wildland resource classes – grouped on the basis of soils, terrain, and vegetative cover similarities – than detailed resource categories. Maurice Nyquist (see article page 7) and Kenneth Raithel of the Denver Service Center lent support and guidance throughout the project.

SCIENCE, February 20, 1981 issue, details the current state of the art of remote sensing as it is now being used routinely in geologic interpretation for mineral and energy exploration, plant siting, waste disposal, and the development of models for regional and continental tectonics. Authors are Alexander F.H. Goetz, a senior member of the technical staff of the Jet Propulsion Lab, Cal/Tech, Pasadena 91109, and Lawrence C. Rowan, geologist with the USGS, Reston, VA 22092. "New spaceborne methods and associated technologies are being developed to produce data from which geologic information about large areas can be derived much more rapidly than by conventional techniques," they state.

The urgency of developing social systems that can keep pace with technology drew a nod of recognition from Alex Hills and M. Granger Morgan, authors of "Telecommunications in Alaskan Villages," in the January 16, 1981 issue of **SCIENCE.** The article describes a recently installed satellite system now providing modern long-distance telecommunication services to 100 rural Alaskan villages, most of whose residents are Alaska Natives. The authors look at the need for both hardware and organizational components that will be required to deliver television in Alaska villages, and conclude that the "organizational arrangements may be the more important, since they will probably endure far longer than any particular technical solution." The article considers the specifics of technical and organizational structures and the various possible roles of state and private influence.

Wrangell St. Elias Bibliography Ready

An annotated bibliography of Wrangell St. Elias NP by R. Gerald Wright is available in CPSU Report form from the University of Idaho CPSU at Moscow, ID 83843. It contains more than 300 citations, numbered and listed alphabetically and categorized into 18 subject areas.

"Two Aspects of Scientific Responsibility," by John T. Edsall, Harvard emeritus professor of biochemistry and former chairman of the AAAS Committee on Scientific Freedom and Responsibility, appears in the April 3, 1981 issue of **SCIENCE.** He discusses the rigorous world of scientific research and the equally important communication of results, and the associated responsibilities of a very different order – the choices in the area of social responsibility and political decisions. He speaks of value judgments that stem from research results – "the uses and hazards of toxic chemicals and radioactive materials, the choice among various modes of producing or conserving energy, or the criteria for deciding whether to dam a river or let it flow freely." These are very different problems from those of basic research, he says, "Nevertheless, applied scientific knowledge is an important element in the making of such decisions." Because science – and therefore scientists – are so often plunged into these areas of disputation, it behooves the scientist to consider carefully what constitutes responsible behavior.

The new 1981 **CONSERVATION DIRECTORY** is available for $6 by writing to the National Wildlife Federation, 1412 16th St., N.W., Washington, D.C. 20036, The 300-page directory lists about 12,000 individuals and 1,800 organizations concerned with natural resource use and management.

JOURNAL OF FORESTRY for January 1981 carries an article by J. Robert Stottlemyer, former chief scientist of the NPS Mid-Atlantic Region, entitled "Evolution of Management Policy and Research in the National Parks." He traces management policies through the years since 1916, when the Park Service came into being, and compares them with the mandates described in various parks' enabling legislation. He makes a strong case for continuing research within park boundaries and cites present administrative authority as being "sufficient to mitigate most countervailing factors originating within park boundaries," but concludes that "the most significant challenges . . . now come from beyond park boundaries" and acknowledges that "their solution is very complex and will challenge the best scientific expertise."

Managers whose responsibilities include old-growth coniferous forests will find much of interest in USFS General Technical Report PNW-118, **Ecological Characteristics of Old-Growth Douglas-fir Forests,** published in February 1981. With the end of unreserved old-growth forests a mere matter of four decades or less away, the report suggests that, "the public, scientists, and land managers are increasingly concerned about whether species, communities, and functions are in danger of being eliminated. Although the authors (Jerry F. Franklin, Kermit Cromack, Jr., William Denison, Arthur McKee, Chris Maser, James Sedell, Fred Swanson and Glen Juday) found a few plant or animal species solely confined to old-growth forests, they identified several species as finding optimum habitat in such forests and a few that "may require old-growth to maintain viable populations." The 48 p. GTR is available from the Pacific Northwest Forest and Range Experiment Station, Portland, OR 97232.

THE SCIENCES, published 10 times a year by the New York Academy of Sciences, is a forum for scientists to discuss current issues and research developments in a non-technical format. Beginning in 1961 as a 16-page, pocket-sized pamphlet, listing the Academy's monthly program of activities, it has grown to an 8½ by 11-inch format with 32 or more pages per issue. Each issue contains at least four major articles on current research, science policy and cultural affairs, plus several departments. Single issues sell at some news stands for $1.50; a subscription costs $12.50 per year and may be ordered by writing *The Sciences*, Subscription Dept., 2 East 63rd St., New York, N.Y. 10021. Surveys show that 84 percent of the readers hold an MD or a PH.D., and an even higher percentage have authored papers in primary journals. It is aimed at the working scientist who is interested in developments in other fields, and written in terminology that is readily understandable to the educated layperson.

INFORMATION CROSSFILE

NEXUS, in its Winter 1981 issue, (951 Highland St., Ipswich, MA 01938), carries several articles on peat bogs – how they are formed, their curious preservative properties (over 600 human bodies – one estimated to be 2,000 years old, numerous prehistoric animals and pollen grains found in European bogs have recorded the millenia of bog evolution), and the possible energy future of Maine and New Brunswick's bogs. In an accompanying editorial, Carrie Koplinka writes:

"Drawing an appropriate line between peatland development and preservation requires that the decision makers – citizens, scientists, lobbyists, politicians – have a clear understanding of the resource and carefully consider the impact which management will have on the ecosystem for today and tomorrow."

A NEW HANDBOOK about the petrified forests of Yellowstone – entombed by volcanic eruptions 50 million years ago – is now available from the Superintendent of Documents, U.S. Govt. Printing Office, Washington, D.C. 20402. The price is $2 and stock number is 024-005-00786-5. The 32-page handbook, issued by the National Park Service, is by Dr. Erling Dorf, professor emeritus at Princeton University. Based on extensive field studies and laboratory analyses of fossil speciments, the book describes the more than 25 living forests in the area that were buried upright and revegetated over a period of 20,000 years. In addition, it contains graphic summaries of current theories about the hot spots below Yellowstone Lake and elsewhere in the park.

The **IUCN BULLETIN** (out of Gland, Switzerland 1196) for November-December 1980 carries word about the remarkable interdependence of fish and forest in the Amazon basin. A survey showed that the Amazon and its tributaries flood a 40,000 square mile area between June and November, and when this happens the fish migrate into the forest and feed on the seeds and fruits falling into the water. The trees, in turn, depend on the fish to distribute their seeds. More than 200 fish and tree species have been identified as relying on one another in this way. The fish have become specially adapted with molars to crunch nuts and bloated stomachs to enable them to build up a store of fat for the dry season when the rivers retreat.

"Management of Western Forests and Grasslands for Non-game Birds," the proceedings of a workshop held earlier this year, has been published and is available from the U.S. Forest Service, Ogden, Utah 84401.

Island Night Lizard Study Initiated

By Gary M. Fellers

The island night lizard is listed federally as a threatened species. It is found only on three islands off the coast of southern California; one of these, Santa Barbara Island, is part of Channel Islands NP.

Currently, very little is known about the abundance, distribution or ecology of this rare lizard. Knowledge of its life history is a necessary part of the program to reduce or eliminate the rabbit population on Santa Barbara Island. The lizard study now underway there will also provide useful data as to where visitor use should be discouraged in the interests of protecting the lizard and where such visitations would have no significant impact.

Even more important, data on lizard habitat preference will be essential for planning any major effort to control or eliminate exotic plants, especially iceplant. (In following park practice of restoring sites to pre-manipulative conditions, we don't want inadvertently to destroy important habitat for an endangered species.)

Working with Charles Drost, a graduate student at the University of California, I have begun a study designed to fill the major voids in our knowledge. In January we worked with two VIP's (Volunteers in Parks) to install 150 pitfall traps (one gallon plastic jars) to capture lizards. About 50-75 traps are operated at a time and are checked on a daily basis. By repeatedly capturing marked individuals, we can evaluate patterns of movement and population density for each of several major habitats on the island. We also are gathering information on growth rates, food habits and reproductive effort.

Fellers is assistant chief scientist for the NPS Western Region.

***The ferocious character** (above) is the endangered Island Night Lizard, found on Santa Barbara in the Channel Islands NP. Suspended in a weighing bag, the lizard's ability to strike terror doesn't impress researcher Charles Drost.*

OREGON WILDLIFE for March 1981 contains a story on the common pigeon (or rock dove), with encouraging words for the endangered peregrine falcon. It describes the lifehabits and nuisance quotient of rock doves in relation to city structures and dwellers. ("The birds have been known to pick mortar from between bricks to use as grit, thus weakening the structures. The health and aesthetic problems surrounding pigeon droppings also are well known.") And then it prophesies:

"Now that the worst pollution (of cities) has been cleaned up, the peregrine pilot program appears to be working. In the end, the predator-prey relationship (that held in cities a century ago) may once again make the noble falcon a city bird and the rock dove a useful link in the biological food chain."

RMP's — The Next Step

By Bill Supernaugh

"Let's see now, if the park's GMP or DCP's have an approved EIS, then the SRP's which get written up in the RMP only need an EA, but . . ."

The new year brings new anagrams and, we believe, a renewed commitment and directive to carry out our primary mandate to preserve and protect the natural and cultural resources that are integral to the existence of the 320 or so units of the National Park System.

December brought forth the long awaited guideline for dealing with resource planning and programming in a uniform manner. It became policy to treat both natural and cultural resources in a common document and the required content of Resources Management Plans (RMP's) was set out along with a time frame to be met.

The Plan, in effect, becomes a compendium of management decisions proposed to be carried out in order to meet a legislative, regulatory, or policy requirement. The accomplishment of any single action might be for the benefit of a specific cultural resource or of a type that will affect several resource components in both natural and cultural categories. *The important element to be grasped is the need for the decision official to be able to project what the cumulative effect of the action will be on the entire park's resource inventory.*

It is therefore necessary to include project statements on *all* of the park's ongoing and anticipated activities which involve manipulation of the resource. This will require the manager to evaluate the resources under his/her stewardship and make accountable decisions based on an awareness of how maintenance, protection, monitoring and research will ultimately affect all resources.

This long range goal will be accomplished through a time-phased program to be carried out in 1981. During January, park staffs articulated Significant Resource Problems (SRP's) that warranted special identification and emphasis. Prioritized SRP's (cultural and natural), supported by 10-237/238 funding requests were reviewed and integrated into Regional SRP listings.

The Regional Directors and Directorate met in February to develop a Servicewide list in priority order – used as a component of the FY83 budget submission. It follows then that the SRP's also will indicate the projects to which the FY83 research budget submission will be directed. Those research activities that need to be carried out in order to deal with the Service's highest priority resource management problems will be given primary emphasis for WASO funding. Regions and parks are expected to make the same sort of decisions with regard to discretionary funds for research at every level.

The SRP's thus identified will, in most cases, become the core of complex action issues documented in the area's Resources Management Plan, which should be completed and approved by Regions prior to Dec. 1, 1981. Emphasis and support should be given to completing RMP's in each area where no approved Plan now exists. Regional staff and parks should identify those areas having Plans which require major changes or have not received updates, and see that those areas are given the direction needed to meet the due date.

Where the Regional Director finds that a currently approved RMP adequately addresses the action plans, a comprehensive narrative summary – which is the decision-support component – must still be submitted. The five-year strategy for accomplishing recommended resources management actions must include a schedule of proposed accomplishments and staffing and funding needs (in sufficient detail to allow annual progress evaluation), in priority order. After all, commitment, accomplishment and accountability are the name of the game!

The Resources Management Plans are but a single element surfacing during the 1981-82 budget years which will tie together a Servicewide effort – crossing all Divisional lines – and involve us all in an integrated effort to rebuild, rededicate, and reinforce our perspective of resources for the future.

Bill Supernaugh is a resources management specialist, Division of Natural Resources, WASO.

***Charles L. Douglas** is shown here radio tracking burros in Wild rose Canyon, Death Valley National Monument.*

Burro Impact On Bighorn Habitat Studied

By Charles L. Douglas

A study of ecosystem alteration within a national park by an exotic species of animal – eight years in the building and still five years from completion – is yielding information vital to the management of bighorn sheep and burro populations in Death Valley, and with implications for management of similar exotic intrusions elsewhere in the National Park System.

The problem of exotics is widespread in the Park System – ranging from mongoose, rats and feral goats in Hawaiian parks to feral pigs in the Great Smoky Mountains and feral burros in Grand Canyon, Bandelier, Lake Mead and Death Valley. Exotic plants, birds and mammals have been established almost everywhere, and unfortunately they often survive at the expense of native species.

Our studies in Death Valley (DEVA) began in 1973. Overgrazing by feral burros had led to reduction in habitat of the endangered desert bighorn, and management needed to understand the nature, severity, and consequences of burro-bighorn interaction there. Burro control stopped in the 1950s and the herd had increased steadily, while the bighorn decreased commensurately.

Burro impact is a degradative process, insidious and severe. It affects plant species composition and cover, promotes aridity by increasing erosion through soil compaction and surface disturbances, and adversely affects water sources by fouling and usurpation.

Subtle changes in the ecosystem such as changes in soil organisms, losses of invertebrate segments of the food web, changes in small mammals, impacts on ground-nesting birds, and overall effects on nutrient and energy exchange, may never by fully understood. Perturbations reverberate throughout the system, and deserts are especially sensitive and vulnerable to changes. Recovery may require centuries; however, enlightened management may be able to shorten the recovery period.

Managers also need information on endangered plants as well as a detailed vegetational map of the park. To amass these data, we started in the southernmost mountains on the east side of the park and then worked counter-clockwise, range by range. Graduate investigators now are completing thesis on flora and community structure in the first two ranges; a third study is underway . . . all providing data important in evaluating the extent and condition of bighorn habitat.

We hope within another five years, to complete vegetational mapping, bighorn habitat evaluation, population assessments, and management recommendations for the entire park – an area encom-

passing almost as much terrain as Yosemite, Great Smoky Mountains, and Glacier National Parks combined.

Our two-year telemetry and marking study of burro movements and distribution in the Wildrose area of DEVA showed a disturbed herd with a yearly 18 percent rate of increase. Half of all plants in its 600 square kilometer area showed browse impact, with favored species browsed to the brink of elimination.

A concurrent study by a University of Nevada (Las Vegas) graduate student clarified aspects of burro physiology. This knowledge enabled us to evaluate the herd's past exposure to disease organisms that might be useful for management, and to establish normal blood values of healthy animals.

A second study area – Butte Valley – was chosen for its isolation and because bighorn were thought to be more numerous there. Again, we used telemetry- and marking-collars and replicated parts of our research. This was important because conditions were significantly different there; herd density was much higher, home ranges were constricted; emigration of young animals was taking place, and the plant community and burro herd had established equilibrium. Thus, the two study areas represent extremes along a continuum of habitat degradation.

Variation in coat colors throughout the Panamint Mountains made us curious about the extent of movements between burro groups. In some herds, burros had mostly dark coats; others were shades of gray or brown. In Butte Valley, colors ranged from white through browns and grays to black. We realized that if there were high interchange between groups, efforts to remove burros from one area could be negated by influx from adjacent areas.

In 1976, a study of population genetics was conducted. Significantly, we found that burros from five localities were largely isolated from one another genetically. Even herds in adjacent canyons operated as separate breeding units. Explanation lies in the fact that the peak of breeding coincides with the hottest months of summer, when burros are under the most water stress. Consequently, they remain near springs and breed with individuals in the same canyon. In winter, with water stress reduced, adjacent herds intermingle, but breeding in winter is greatly reduced so interbreeding is negligible.

For management purposes, the importance of these results is the discovery that burros are faithful to their home range areas and probably can be removed from small areas without the vacancies immediately being filled by other individuals.

In 1979, the Tin Mountain-Quartz Spring area was found to contain bighorns and burros in sufficient numbers to permit simultaneous study. We are beginning now to unravel some of the complexities of resource partitioning between these species. We consider food, space, and water sources. The studies indicate that burros and bighorns in the Tin Mountain area use some of the same terrain. Bighorn appear to use ridges and upper slopes more than burros; and rams appear less restricted by burros than ewes and lambs are. Such knowledge is fundamental to an understanding of competitive interactions.

Ungulates are either selective feeders, or generalists. Burros probably are more general in their food habits than bighorn. Burros are larger and require much more food and water than bighorns. Burros also can exist on poorer quality forage because they are able to vary the rate of gut clearance by continued eating, whereas ruminants do not have this option.

Food habits of both species are being analyzed monthly. The ability of a ewe to raise a lamb through weaning depends upon adequate water and proper nutrition. Nutrient and energy content of major forage species are being studied so that nutritional stress periods can be identified. Major competition for forage resources could occur during these stressful periods.

Competition between ungulates is difficult to prove. We intend to study the distribution and seasonal use areas of burros and bighorn in the Tin Mountain area for two years, then remove burros and document the responses of bighorn. Bighorn may expand their home ranges and use areas. This is not certain owing to intangibles such as the length of time the bighorn range has been constricted, and the possibility that degraded vegetation adjacent to present bighorn habitat may not be able to support bighorn at this time.

Throughout California, and most of Death Valley, bighorn exist in habitat islands that are remnants of former range. Populations have been fragmented by changes in vegetation caused by overgrazing, by road construction, and by disappearance of traditional watering sources.

Small remnant herds of sheep almost surely will not survive indefinitely. Population geneticists estimate that if a herd remains at 50 animals for 20-30 generations, about 25 percent of their genetic variation will be lost. The smaller the herd, the greater the effects of inbreeding depression, which leads to lowered immune responses and reduced vitality. One obvious sign of such problems is reduced survival of lambs. A herd of 25 animals can experience a 25 percent lowering of reproduction within five years. Most herds in DEVA have fewer than 50 animals. Some have fewer than 25, which makes them extremely vulnerable to extirpation. Diseases also present special and severe threats to small groups. Some herds have died out in California during recent times; others presently are showing almost no survival of offspring. A few herds are doing extremely well.

If bighorn sheep are to be preserved in DEVA for more than another 100 years or so, isolated remnants of the herd must be encouraged to rejoin one another as an interbreeding entity. Restoration of bighorn habitat and reconnection of habitat fragments, by means of corridors, depends upon removing burros. Without burro removal, any habitat restoration for bighorn is likely also to enhance that habitat for burros.

Innovative and aggressive management is required if bighorn are to survive in DEVA. Restoration of burro-impacted areas in bighorn habitat, and rejoining isolates of the herd will require a long-term commitment. But tremendous as the challenge is, it consists equally of opportunity – the chance for NPS managers and scientists, together, to demonstrate that a resource problem of this magnitude *can* be dealt with in an aggressive, cost-effective and timely manner.

Editor's Note: The majority of studies associated with this project are in-house and funded by the CPSU. For additional information on these studies, contact Charles Douglas, senior research scientist and leader of the NPS/CPSU at University of Nevada, Las Vegas, NV 89154. Comm. No. (702) 385-6468; FTS 8-598-6468.

Weighing burros *is part of the effort to understand burro behavior and management in Death Valley, NM.*

PACIFIC PARK SCIENCE

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U.S. DEPARTMENT OF THE INTERIOR

SPRING 1981

Coastal Management at Gateway NRA

"Coastal Management Policy Emphasis in an Urban National Recreation Area" is the title of a paper included in the proceedings of the Coastal '80 Conference held last November in Florida. Authored by Gateway NRA Supt. Herbert S. Cables, Jr., and Natural Resources Management Specialist John T. Tanacredi, the paper explores the myriad of management activities that will be necessary in the development of this NRA – such specific management scenarios as barrier beach and bathing beach stabilization, marsh stabilization, water quality and public health aspects of bathing beaches, wildlife refuge resources, and the coupling of research priorities in the National Parks with management decisions in our coastal zone.

The paper deals with "the paradox of Gateway" – its potential as a recreation resource, and the ways its advantages of location are offset by the severe stresses to the park's lands and waters because of the densely populated, highly urbanized area in which they lie. In short, one of its main advantages is at the same time one of its most severe drawbacks.

However, even given these stresses, Gateway's barrier beaches, marshes, upland forests and bay provide unparalleled opportunities for experiencing a natural coastal system.

"In order to properly harmonize the varied areas encompassing Gateway, the park has been allocated into six management zones," the paper states, "each of which has specific management strategies and types of allowable use and development. Offshore waters, including those of Jamaica Bay, have not been zoned. The six zones are Protection, Use-by-Reservation, Beach, Unstructured Recreation, Structured Recreation, and Development. The Development zone includes two subzones: Support and Gateway Village."

The paper describes the Protection Zone as including "natural areas so sensitive to human activity that they will be available for use only under special conditions." Included are high and low salt marshes, primary dunes, freshwater marshes, and identified critical areas such as waterbird nesting sites. Uses of lands in the Protection Zones will be strictly regulated and confined to research and maintenance.

Areas sensitive to overuse will be zoned for use-by-reservation, enabling management to control access. Included in this zone are most forests, some upland marsh areas and secondary dunes, and grasslands with significant values. Special use areas such as nurseries and horticultural experiment sites will be placed in this zone, and low impact uses such as nature study, environmental education, and historical interpretation will be allowed.

The Beach Zone encompasses ocean and bay shores able to take moderate to substantial recreation use. Management strategies will reflect shoreline dynamics (interrupting them only as necessary to reduce erosion and maintain beach use in major public use areas). Techniques may include maintenance or establishment of dune systems, plantings, windbreaks, and sand nourishment to provide for planned levels of recreation use . . . swimming, surfing, sunbathing, beachcombing and, in a few locations, surf fishing.

Unstructured Recreation Zones are predominantly natural areas other than beach that can accommodate recreational use. They include open grassland/thicket areas with no particularly sensitive resources, managed to preserve the vegetation and scenery while establishing sites that support casual outdoor uses. Species that can coexist in such areas will be protected by appropriate management techniques (e.g. Ringed neck pheasants, rabbits, owls, grasshopper sparrows, etc.) Picnicking, walking, birding, kite flying, biking and informal athletics – activities requiring little supervision and few support facilities – belong here.

Structured Recreation zones encompass outdoor areas that can be developed and landscaped to support active organized sports and recreation . . . all activities that require hard surfaces, structured grounds and playing fields.

The Gateway Village concept (within the Development Zone) will establish at Floyd Bennett Field in Brooklyn and at Fort Wadsworth in Staten Island activities like those already happening at Fort Hancock in Sandy Hook – educational programs, theatrical productions, research by other federal, state and local agencies, community events, day camping, formal and informal athletics, staff housing, historical interpretation and organized group outings.

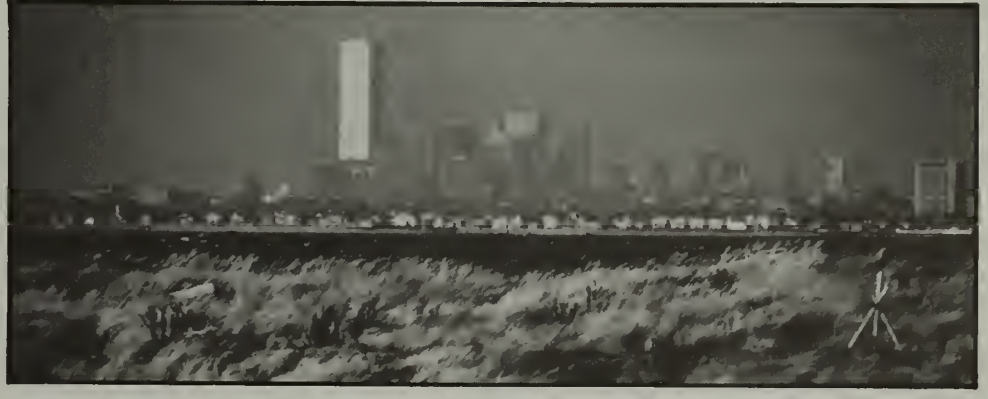
The Gateway concept derives from ecological principles which demonstrate the inter-dependence that binds natural and urban systems together and a recognition that it is no longer constructive for those who consider themselves environmentalists to separate their concern for the manmade environment from the rest of the natural world.

Coastal Resources Policy Implementation – the final section of the paper – deals with "management scenarios." The key word is "flexible," and Cables and Tanacredi argue that "letting nature take its course is in concert with the conservation/preservation ethic of the National Park Service" in addition to which, they note, it often "is the most economical way to handle a particular ecological situation."

A rich variety of management problems, proposed solutions, and actual projects follow. One example deals with Floyd Bennett Field, where "planners failed to recognize that restoration (return of the site to natural processes) would have resulted in erosion and destructive modification of the entire site by swift tidal currents through the Jamaica Bay inlet system. Flexible coastal management approaches coupled with sound scientific data averted a potentially significant alteration to the Floyd Bennett Field area for the future."

Sludge disposal, landfill operations, refuge management all figure in the scenario section of this paper. Conclusions emphasize the bridging of the gap between scientific research in parks and traditional interpretive skills. "This type of interpretive connection," the author writes, "the taking of complex scientific data and making it palatable to the general public, will reduce the scientific credibility gap . . . At Gateway, management is integrating this coastal ecosystem consciousness into its daily and longterm development."

(The complete paper is available from Tanacredi at Gateway NRA, Hdqts. Bldg. 69, Floyd Bennett Field, Brooklyn, N.Y. 11234.)



URBAN REFUGE: *Jamaica Bay Refuge, presents stirring contrasts and complex management problems.*

PACIFIC PARK SCIENCE

NATIONAL PARK SERVICE
U.S. Department of the Interior

AID/NPS Bulletin Full of Readable Technical Briefs

An 8-page prototype report entitled "Natural Resource Technical Bulletin" was published in March by the National Park Service's international division for AID . . . one of the products of the AID/NPS project "Environment and Natural Resources: Expanded Information Base."

Aimed at helping AID missions, host country counterparts and other development organizations make efficient use of the vast existing knowledge available in this field, the bulletin will highlight significant new information on environmental aspects of development. The Park Service was selected for leadership in this effort because of its long experience in managing a wide variety of habitats, its ecosystem approach to management, its links with experts in environmental fields, and its record of striving to balance development with environmental protection.

Although its target is international, the prototype bulletin contains technical briefs and books reviews of interest to scientists and managers of parks in this country. Future issues will include articles on natural resources planning and management, with emphasis on field study-based materials.

Hugh Bell Muller, manager of the AID/NPS Cooperative Program, described three contracts now underway – each involving a specific product. The contract with the National Academy of Sciences involves development in the humid tropics; a contract with the International Institute for Environment and Development is looking at ways developing countries are handling environmental issues, and a third contract, with the American Association for the Advancement of Science, is surveying methods for conducting resources inventories and baseline studies.

Information about this program and copies of the bulletin may be had by writing Muller, Office of International Park Affairs, NPS, DI, Washington, D.C. 20240 or calling on FTS 523-0150.

In the Next Issue:

We went to press again too fast to get everything we promised into this issue. So Jim Thompson's piece on "Scientific Management in the Rocky Mountain Region" and Jay Gogue's "Acid Rain" article will be in the ensuing issue. Gary Hendrix will have an article on "Saving of the East Everglades," Roy Johnson's second article on riparian systems management will deal with the Colorado River, and Brad Griffith will describe his mule deer project at Craters of the Moon. Several articles on specific research in Biosphere Reserves will introduce a new section on Man and the Biosphere (MAB) projects in the National Parks.